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GEOSYNTHETICS USED TO STABILIZE THE SUBGRADE

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ABSTRACT
The repetitive, high, and targeted stresses placed on pavements, whether bound or unbound, may hasten the ageing and collapse of the road structure. The main aim of the study is stabilization of subgrade using geosynthetics .Soil stabilization is a process of treating a soil to maintain, alter or improve the performance of the soil as a construction material and very importantly to minimize the cost of earthworks. In order to determine the preliminary and engineering (strength) testing of the samples, analysis were carried out. In this study, the results of studies on the performance of non-woven geotextile within subgrade are carried out experimentally utilizing the California Bearing Ratio(CBR) testing arrangement.The experimental results give a clear indication that the presence of geotextiles increases the CBR value of the soil thus, geotextile should be employed as a modernized form of improving road construction on poor soils and to reduce the layer thickness of paveme*nts.*
Keywords: *Stabilization, geotextile, CBR, pavement, soil etc.*

1. INTRODUCTION
Maintaining and developing pavement infrastructure is a constant challenge for engineers. It is necessary to use high-quality materials in pavement design and construction in order to meet building requirements. Quality materials are hard to get by in many parts of the world. These limitations push engineers to search for alternate solutions that use lower-quality materials, commercial construction aids, and novel design approaches. They are not always successful in this endeavour. Geosynthetics are a type of commercial construction assistance. Many different geotextiles, geo-mesh and geo-composites are included in this category.

1.1 GEOSYNTHETICS
Many civil engineering applications benefit from the use of geosynthetics with high tensile strength combined with soils with high compressive strength. Geosynthetics may be used in a variety of fields, including geotechnical, transportation, hydraulics, and geo-environmental engineering. Materials used in geosynthetics production are mostly synthetic and typically produced from crude oil, through rubber and fibreglass. Geosynthetics is a general term that encompasses a wide range of planar products that are manufactured from compound materials. When it comes to materials, the most commonly used ones are soil- and rockcontacting geotextiles (e.g. Geogrid, GeoNet, GeoMembrane), as well as alternative materials such composites (Geocomposites). 'geosynthetics' comprises two components:
GEO refers to an end-use connected to increasing the effectiveness of applied scientific tasks involving the earth/ground/soil.
It is the exact fact that the materials are almost entirely synthetic that is the subject matter of "SYNTHETICS."

1.2 GEOSYNTHETICS-REINFORCED MECHANICAL STABILIZATION OF SOIL
Mechanical Stabilization is the process of enhancing a system's specific technical qualities by the application of mechanical pressure and force. Creating a Mechanically Stabilized Layer (MSL) by removing weak, moist, or otherwise unsuitable soils and replacing them with a designed fill is one sort of Mechanical Stabilization. In order to enhance the ground for an intended purpose, an engineered fill is material that has been deposited and compacted in line with predetermined design specifications. The artificial fill is constructed of granular, nonorganic soil. However, in most situations of mechanical stabilisation, notably for highways and pavements, the designed fill is

formed of crushed stone aggregate. It is possible for the contractor to use less crushed stone aggregate and less undercut by using Mirafi® geosynthetics for mechanical stabilisation, which strengthen and improve the performance of the crushed stone aggregate.

2. LITERATURE REVIEW

Oleiwi, Ghusoon et al., (2021) The use of geosynthetics for subgrade reinforcement has increased considerably in recent years. However, the total effectiveness of such an enhancement depends on the selection of the geo-material that is appropriate for the site characteristics and soil type. An important consideration when assessing this form of ground treatment is how long it will last and how much it will cost to build. There is also a list of geosynthetic kinds, uses, and functions. Geofabrics-subgrade reinforcement effectiveness is examined in relation to soil type and attributes. In addition, the usefulness of geosynthetics in extending the lifespan of roads and reducing their construction costs is explored. According to the research, the technique can help reinforce the soft subgrade, extending the service life of the roadway, decreasing construction costs, and reducing the rutting deformation associated with the roadway. Most of the studies in this study have indicated that using geosynthetics in pavements to alleviate the vertical stress on the subgrade beneath a wheel route is effective. The impact, on the other hand, was site-specific and related to the type of geomaterial used.
Jayakumar, Jayashree et al., (2020) Because of its cohesive nature, clay is a fine-grained soil that becomes pliable when it is wet. Clay soils have a low CBR because of the alternating swelling and shrinking they experience when moisture content changes. Subgrade stabilization has been achieved using layers of geosynthetics in this study. The geosynthetics used are nonwoven geotextiles and geogrid layers. Atterberg limits and grain size distribution of the clay samples are evaluated for engineering and index properties, respectively. At 3.54 percent for the control sample, the CBR Test value increased by 4 percent and by 5.56 percent after geogrids were put in their proper places in the middle. Enhanced performance is achieved when Geogrid and geotextile are applied as a single layer. 6.31 And 6.9 percent, respectively, were found in the CBR tests for the combined layers at the top and center.
G. Janakiraman et al., (2019) The process of increasing the soil's major features in order to increase its strength, durability, and other attributes by the blend or mixing of chemicals is known as soil stabilisation. The dissimilar forms of technique used for soil stabilisation are: Soil stabilisation with cement, Soil stabilisation with lime, Soil stabilisation victimisation hydrocarbon, and Chemical stabilisation associated an innovative promising experience of stabilisation by Geo textiles and Geo artificial fibres. Geotextiles have been efficiently employed for reinforcing of soils to regain the bearing capacity. Roads are arteries of a city and a rise in population boosts traffic. Heavy traffic needs robust, smooth, durable and wellmaintained road surface and consequently healthy and improved road network is necessary for socioeconomic growth of a country. It is common practise to reinforce road pavement with a variety of materials, with geosynthetics being one of the most popular. Geosynthetics are synthetic compounds used to stabilise terrain. Geotextiles, both natural and synthetic, will be studied in greater depth in this research in order to better fortify the subgrade soil. This study exhibits effect of reinforcing of Geotextiles on sub grade soil.
Sandeep Kumar and Arti Chouksey (2018). Soil is the essential basis for all civil engineering constructions. It is essential to endure the weights without failing. In some regions, soil may be weak which cannot resist the incoming loads for which soil stabilisation is essential. Numerous strategies are known in literature for soil stabilisation. But occasionally some of the procedures like chemical stabilisation, etc., adversely alter the chemical makeup of the soil. Geosynthetics is manufactured material used for soil stabilisation; geogrid mesh may be inserted in the soil to strengthen the strength of the weak soil. Whenever soil is subjected to shear loads, geosynthetic materials are employed to prevent the soil from deforming in an unintended direction. To enhance the property of soil, Geosynthetics is employed which increases the bearing capacity and permeability of soil, and also

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decreases the settling of soil. Fly ash is combined with soil to explore the relative strength gain in term of bearing capacity and compaction. In this work an attempt has been made to measure the strength of soil by employing a multilayer geogrid in the soil and by conducting grain size distribution, conventional Proctor compaction tests, OMC testing, and CBR tests. The experimentation findings indicate that how the usage of geo-gird and fly ash leads to successfully increase the property of soil.

Eisa, Mohamed et al., (2018) Poor subgrade soil is a recipe for disaster when it comes to laying down a pavement section. Pavement portions suffer persistent deformation as a result of these issues, resulting in poor road usability and structural damage. Both clay lumped soil and sandy friable soil, two types of weak subgrade soils, were employed to create pavement sections for the current study's pavements. Plate loading tests were performed on the pavement portions both before and after they had been reinforced with geosynthetic sheets in various ways. To assess the resistance to static load deformation of each kind of subgrade soils and figure out the optimum technique to strengthen the base and subgrade layers of the pavement sections, a four model of pavement section would produce of each subgrade. As a baseline, the first model was constructed without any geosynthetic reinforcement, and the subsequent models demonstrate three distinct methods for adding it.

3. OBJECTIVES OF THE STUDY

- To study the framework of Geo-synthetics in detail.
- To discuss concept of soil stabilization and its purpose.

4. EXPERIMENTAL PROCEDURE.

Materials Various soil samples, including lateritic and clay were collected and used for the experiment. The non-woven geotextile was also collected and used. Polythene was used to keep moisture from escaping the soil samples.

4.1 Test Procedure

In order to determine the preliminary and engineering (strength) testing of the samples, analyses were carried out. Reinforcement ratios were also used to assess performance and quantify how much of an improvement in penetration resistance could be seen in both soil samples and soil non-woven geotextiles, based on CBR load–penetration relations. At a certain penetration, the reinforcement ratio is:

$$\text{Reinforcement ratio} = \frac{\text{Load with geotextile}}{\text{Load without geotextile}}$$

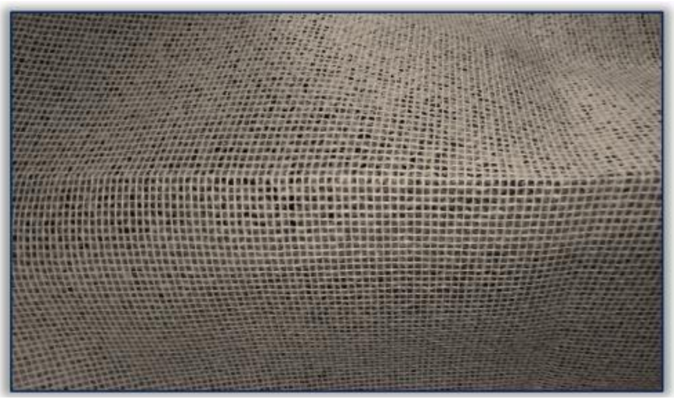

Figure 1: Sample of the non-woven geotextile material used.

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5.RESULTS AND DISCUSSION:

Tables 1–3, we summarize the findings of preliminary tests (such as grain size analysis), engineering tests (such as compaction and California Bearing Ratio testing), and Atterbergs limit tests (such as specific gravity).

5.1 Preliminary Test

The soil samples were subjected to a granular material particle size distribution test, which was carried out using a technique known as the grain size analysis test. Because it is not plastic, sample C has no plastic limit or plasticity index based on the results of the Atterberg limit test. Samples A and B had liquid limits of 35.5%, 43.5%, and 23.5%, respectively. Samples A and B exhibit a medium level of plasticity, while sample C has a low level of plasticity.As can be seen from the data in Table 1, samples A and B have specific gravities between 2.70 and 2.63 and samples C has a specific gravity of 1.98, showing that sample C contains organic compounds while samples A and B are lateritic.

5.2 Preliminary Test

The soil samples were subjected to a granular material particle size distribution test using the grain size analysis test as a method. It is defined as silty gravel (GM) with sand, well-graded sand and clay gravel (GC) (also known as silty clay and sand), or well-graded sand gravel (GW). With liquid limits of 35.5 percent (43.5 percent), 43.5% (23.5%), and 15.3% (11.1%), A and B show intermediate plasticity in the Atterberg limit test while sample C, which lacks a plastic limit or index due to its nonplastic nature, shows low plasticity in the Atterberg limit test. It is clear that samples A, B, and C are lateritic (2.50 – 2.75), clay (2.60 – 2.90), and organic substance-containing sample C, based on their specific gravities.

Table 1: Summary of preliminary test results

Particulars	Sample A	Sample B	Sample C
BIS Classification	GM	GC	GW
Liquid limit (%)	35.50	43.50	23.00
Plastic limit (%)	20.20	29.40	-
Plasticity index (%)	15.30	14.10	-
Specific gravity (g)	2.70	2.63	1.98

Table 2: Summary of compaction test result

Particulars	Sample A	Sample B	Sample C
O.M.C (%)	14.5	12	11.5
M.D.D (g/cm3)	1.35	1.39	1.44

5.3 Engineering Test

Table 2 summarises the results of the compaction test. Soil strength and load-carrying ability may be improved by increasing the quantity of water in the soil, which was established by conducting a test to evaluate the link between the Optimum Moisture Content (OMC) and the Maximum Dry Density (M.D.D).

Table 3: Summary of the CBR values (Soaked condition)

Soil samples	Without non-woven geotextile		CBR value (%)	With non-woven geotextile		CBR value (%)
	2.5mm	5.0mm		2.5mm	5.0mm	
Sample A	2.8	3.2	3.2	9.6	9.7	10
Sample B	5.2	6	6	15.8	13.8	16
Sample C	1.4	1.5	2	2.8	2.6	3

The results of the CBR tests are summarised in Table 3. To put it another way, the non-woven geotextiles increased CBR values far more than they did before their introduction. Non-woven geotextile improves CBR values independent of the depth of installation. Sample B's CBR values were elevated regardless of the conditions, but the percentage rise was much greater when non-woven geotextile was placed at H/4 depth in the top and bottom regions of the sample; nonetheless, this sample performs best when H/4 depth is applied from the bottom area. Nonwoven geotextile can make a big difference if put lower than the effective pressure bulb's depth, because the diameter of the plunger determines the pressure bulb's depth.

6. CONCLUSIONS

The following conclusions were drawn from the study:

- This sample has a liquid limit of 23%, but samples A and B do not meet the selection criterion for subgrade soils since their liquid limits are 35.5 and 43.5 percent higher than sample C's liquid limit.
- A, B and C's soak CBR values increase by 10 percent, 16 percent and 3 percent respectively when non-woven geotextile is employed in comparison to their respective values without non-woven geotextile. It is acceptable to use reinforced soil samples A and B for road and bridge construction.
- In saturated conditions, a non-woven geotextile material boosts penetration resistance and hence CBR, implying that soil and the non-woven geotextile material interact. As a result, employing subgrade CBR as a design criteria for flexible pavements may save construction costs by reducing the thickness of component layers (subbase and base course).

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